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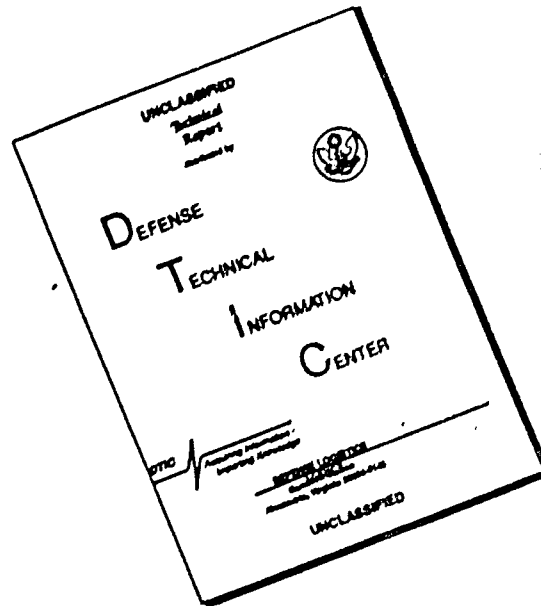
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OFFICE OF THE ADJUTANT GENERAL  
WASHINGTON, D.C. 20310

IN REPLY REFER TO

AGAM-P (M) (11 Jan 68) FOR OT RD 670305

15 January 1968

AD825602

**SUBJECT:** Operational Report - Lessons Learned, Headquarters, 864th Engineer Battalion (Const), Period Ending 30 April 1967

**TO:** SEE DISTRIBUTION

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2. Information contained in this report is provided to insure appropriate benefits in the future from Lessons Learned during current operations, and may be adapted for use in developing training material.

BY ORDER OF THE SECRETARY OF THE ARMY:

*Kenneth G. Wickham*

KENNETH G. WICKHAM  
Major General, USA  
The Adjutant General

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as

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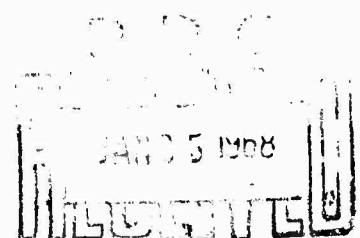
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DEPARTMENT OF THE ARMY  
HEADQUARTERS, 864TH ENGINEER BATTALION (CONSTRUCTION)  
APO 96312

5 EGACBC-3

13 May 1967

SUBJECT: Operational Report - Lessons Learned (RCS CSFOR-65), for Quarterly  
Period Ending (31 April 1967)

THRU: Commanding Officer  
35th Engineer Group (Construction)  
APO 96312

Commanding General  
18th Engineer Brigade  
APO 96377

Commanding General  
US Army Engineer Command Vietnam (PROV)  
ATTN: AVCC-P & O  
APO 96491

Commanding General  
United States Army, Vietnam  
ATTN: AVCGH-DH  
APO 96307

Commander in Chief  
United States Army, Pacific  
ATTN: GPOP-OP  
APO 96588

TO: Assistant Chief of Staff for Force Development  
Department of the Army (ACSFOR DA)  
Washington, D. C. 20310

Section 1. Significant Organization or Unit Activities

1. The battalion is organized under TOE 5-115D dated 19 July 1960; its attached units are the 39th Engineer Detachment (CM&P), the 171st and 588th Well Drilling Detachments and the Asphalt Platoon of the 102nd Engineer Company (CS).

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2. During the period the battalion has undergone major changes in its organizational structure. In March 1967, the 102nd Engineer Company (CS), formerly attached, was reassigned from the 35th Engineer Group (Const) to the 937th Engineer Group (Combat) (See Inclosure 1), except for the asphalt platoon and a portion of the equipment platoon (See Inclosure 2). The reassignment placed an initial hardship on the battalion as the organic Company A quarry personnel were charged with the responsibility of operating the large Cam Ranh Bay quarry complex and the Hon Tre Island quarry, both of which formerly had been run by the battalion and 102nd Engineer Company; initially, production dropped off, but now it has leveled off to about its former figures. In April 1967 the one platoon of the 553rd Engineer Company (Float Bridge), which also had been attached, was reassigned to the 14th Engineer Battalion (Combat). Although the platoon of the 553rd Engineer Company was primarily responsible for the repair and maintenance of the My Ca Float Bridge, it supported battalion operations with vital transportation (bridge trucks) for our construction missions.

3. This reporting period brought with it excellent weather, a welcomed departure from the last period's monsoons. Consequently, construction activity increased greatly. During the first half of the period, the majority of the battalion's construction efforts remained on the Cam Ranh Bay peninsula and in the Nha Trang area. The largest single project at Cam Ranh Bay continued to be the 8630 man cantonment area. Self help construction with engineer assistance progressed rapidly and as of this report, a BOQ area (BOQ's, latrines, showers) and three identical unit areas (billets, messhall, dayrooms, administrative buildings, latrines and showers) are being completed. The battalion is completing a new APO building in the 8630 area which will consolidate all Army mail handling on the peninsula. The battalion's road building mission continued on Cam Ranh Bay's strategic lines of communication. The paving of the My Ca Road was completed in February and the link up with the FMK road paving operation was accomplished. Thus, for the first time the Cam Ranh peninsula has asphaltic concrete paved roads from the LST and lighterage landings at South Beach, through the depot and port area, to the air base and the upper north end of the peninsula. In much of the area there are parallel main paved roads. At Nha Trang, Company C continued with its major project, Hon Tre Island. The completion of the four mile road from the beach to the tactical site at the top was the most significant accomplishment. The road is now being improved and rerouted to eliminate all grades over 20 percent, although it now handles all traffic to the fully operational tactical site on the top. Most of the 600 man cantonment area on the island is complete, and much of it is now in use. Company C was also heavily committed on vertical construction in Nha Trang itself. A 7500 man cantonment area was started at Camp McDermott, and the communications facility for STRATCOM was completed. Overall, during the latter half of the reporting period the center of gravity of the battalion's efforts generally shifted to the mainland and off the peninsula. Since early March, the battalion has completed most of the work on two STRATCOM communication facilities (transmitter and receiver sites with numerous antennas and allied facilities) in the Dong Ba Thin - Suoi Hoa area.

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On 15 March 1967 we made the first start on the country-wide National Highway Rehabilitation Program, starting with route QL-1, the main north-south road of the Vietnamese national road system, and the short QL-1 to Cam Ranh Bay spur. This effort will probably consume the majority of the battalion's construction effort in months to come. It is a mission which makes the battalion extremely proud, as it is the first time that an engineer battalion has done major road building on the national highway network of Vietnam. The project has been closely coordinated with the US Agency for International Development and the RVN Ministry of Public Works, and regional and local offices of the Office of Civil Operation and local provinces and cities. The work itself consists of widening, raising and improving drainage and bridges on the roadbed, plus building a new rock base and adding asphaltic concrete pavement. A few specific activities of each subordinate unit follow:

a. Company A took over complete command and control of the Cam Ranh Bay and Hon Tre Island quarry complex, the cement batching and mixing plant, the asphalt plant and continued with its maintenance and equipment support mission to our three organic construction companies. The scope of these missions (e.g. operating five rock crushers and three quarry sites) are not inherent in the TOE of the company, but rock and concrete production had to be continued at its former pace to keep up with other project requirements despite the extra equipment, much of which is badly worn and beyond economical repair. Additionally, the company opened a new quarry at Ba Ngoi, Vietnam, in support of the road construction on QL-1 and is now making preparations for another quarry crusher site (to include asphalt plant) at Suoi Hoa, in support of the QL-1 work. With the continued operation of the quarry at Hon Tre Island, the company's operations are vastly broader in scope than ever conceived of one battalion. During the period the company's Field Maintenance Platoon handled over 30 engineer and ordnance items per week, which includes repair and maintenance, parts fabrication, parts stockage, and requisitioning. Without this capability to perform our own direct support maintenance of ordnance as well as engineer equipment the battalion simply could not have accomplished its mission. Immediate, same-command, maintenance is absolutely essential to responsive, full-time availability of critical vehicles and equipment. Maintenance is a critical command matter in any unit. In a unit such as an engineer battalion, in which equipment operation is the absolute key to mission accomplishment, it has been vital to have had organic DS maintenance capability.

b. The major construction effort of Company B has been directed toward the STRATCOM facilities at Dong Ba Thin and the 8630 man cantonment area at Cam Ranh Bay. The STRATCOM facilities project involves the clearing and leveling of over 10 acres of heavily vegetated, unsecured area, constructing access roads, protective berms, equipment and generator pads, supply and administration buildings, in addition to the major effort of excavating, forming and pouring 37 concrete bases and 218 deadmen for 11 antennas. To date the project is 75 percent complete. The 8630 man cantonment area, the unit's other major project, is a model development. Earthwork, road building, and vertical construction have been simultaneously accomplished so that the users will derive the full

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benefit upon moving into the area. To date over 40 of 50 total acres is to grade and ready for vertical construction, and the road network is far enough along to pass user as well as construction traffic. Some of the other unit projects during the period included the completion of a POL laboratory, the upgrading of Cam Ranh Bay depot drainage facilities, the extensive access and interior road network for the 71st Artillery administrative and remote tactical sites, the establishment of a concrete block precasting yard and the design and construction of unique precast concrete bridge slabs and abutments for short (10 to 60 foot) bridges on the QL-1 highway project (See Inclosure 5). The cement block work was an innovation in the Cam Ranh Bay area; the first use of blocks was for the security vault of the new APO - - which simplified and sped-up construction. The unit displaced one platoon to the Nha Trang area at the end of the period to aid Company C in vertical construction.

c. The major work of Company C continues to be on Hon Tre Island. The original scope of the project included the island top tactical site, the road to the top and a 450 man cantonment area at the base. To meet Air Force and Army requirements, the scope has been steadily increased and now will include a new and improved road with lessened grades, a modern dog kennel, a 600 man cantonment area (instead of 450 as formerly planned) complete with community facilities, a microwave complex, and a water storage and distribution system including wells. To date over 150,000 man hours and 26,000 equipment hours have been expended on the project. The project is almost 80 percent complete and the end is finally in sight. On the mainland, there were several significant completions and a number of new projects. During the period, a 72,000 gallon POL tank farm, 30,000 square feet of sand cement stabilized LST ramps, and 35,000 square yards of stabilized open storage hardstand were completed. The new projects include a 7500 man cantonment area consisting of 262 buildings of all types and a 2000 man cantonment area which involves upgrading an existing tent area. A prefab operation, which is now in full swing, was established to expedite building construction. Both of these projects are being accomplished with the help of "self help" personnel, with engineer supervision, supply and technical assistance. At the end of the period a shed storage area for the PX was started with the aid of Company B personnel. This includes constructing ten 40' x 100' steel Pasco buildings (but without siding) and an adjacent hardstand area. The unit has also continued its effort on the high priority facilities for the 569th Engineer Company (Topo); five administrative quonsets were completed during the period and are now in use. A 70' x 140' prefabricated "Stran" steep ramp storage building is complete less electrical installation and a large van shed area is now under construction all scheduled for completion in early June. The company also accomplished a large amount of route and quarry reconnaissance during the period and it continued to have one of the major defensive combat roles in the area, which is frequently under enemy harassment.

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d. Company D has continued to perform the majority of the battalion's road building work. During the period, they prepared the base course for surfacing of the interior roads and parking facilities at the 22nd Replacement Center, and one mile of road from the My Ca float bridge to highway QL-1, and on 15 March 1967, they started the QL-1 Road Rehabilitation Project (See Inclosure 6). By the end of the period, 30 April 1967, they had ripped, subgraded and base-rocked 3.8 miles of the heavily travelled road between the float bridge and Dong Ba Thin. This completed Phase I of five phases, which will eventually result in a double lane (24' wide) asphaltic concrete roadway from Ba Ngoi to Dien Khanh (a distance of 29 miles). Thus far, the subgrade preparation has accounted for the placement, grading and compaction of 26,000 cubic yards of laterite and 11,500 cubic yards of 2"(-) rock. Other significant completions during period included: 48,000 square yards of open storage hardstand; an 80' x 200' wooden tropicalized APO building (less electrical); relocation of 1,200 feet of POL pipe; installation of a massive drainage system for the US Army Depot (employing concrete swale ditches); conversion of the My Ca floating bridge to a swinging bridge; placement of 21 concrete two story building slabs; and, continuation of its operation of the largest prefab yard in the area (which consumes about a half million board feet of lumber per month).

e. The 39th Engineer Detachment (Concrete Mixing and Paving), under the command of Company A continued its operation of the central concrete plant. During the period, 10,000 cubic yards of ready mix concrete and 1,500 cubic yards of sand cement was produced for construction in Cam Ranh Bay. Without this plant, the scope of vertical construction operations of all engineer units in the Cam Ranh Bay area would have been reduced drastically.

f. The Asphalt Platoon, 102nd Engineer Company (CS), has been continuously engaged in the operation of the asphalt plant and all paving operations. Although the majority of their parent unit departed the Cam Ranh Bay area, their operations have continued in normal fashion. During the period, they produced approximately 4,000 tons of asphalt and paved 30,000 square yards of roads and hardstands.

g. The 171st and 588th Detachments (Well Drilling) under the command of Company C continued their well drilling operations on Hon Tre Island. Difficulties were encountered in drilling through clay and boulders and blasting was often required. Drill bits continuously got stuck in rock fractures and operations became slow and tedious. Despite these problems one well was completed and another well was started.

4. The battalion was engaged in training 12 half days during the period. Training is conducted on Sunday mornings and in the evenings when mandatory subjects are presented. Extensive, organized on-the-job training activities are carried on and full scale maintenance programs continue (See Inclosure 3). Officer and NCO classes are held twice weekly on such subjects as equipment maintenance and construction operations.

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### Section 2, Part 1, Observations (Lessons Learned)

#### a. Personnel

##### Skilled Personnel

ITEM: Shortage of skilled electricians and plumbers.

DISCUSSION: Many of the projects that have been assigned to date include sophisticated electrical and plumbing requirements (eq. STRATCOM Facility, APO Building, POL Lab). Although the TOE provides sufficient slots for electricians and plumbers in each construction company, personnel occupying these positions are often on-the-job trainees rather than school trained. As a result, electrical and plumbing installation fall behind vertical construction and require a pooling of resources within the battalion to accomplish the task.

OBSERVATION: It is essential that skilled, school trained, plumbers and electricians be assigned to engineer construction units.

#### b. Organization

##### Engineer Equipment and Maintenance Company -- Operations Section

ITEM: TOE 5-117D does not make provisions for an operations section.

DISCUSSION: It is inherent within the missions of the Equipment and Maintenance Company to provide construction specialists and specialized equipment, yet there is no operations section within the unit to handle these daily requirements and to coordinate company activities. In fact, in our particular instance, Company A operations are more widely spread than any of the construction companies (this is usually the case with other construction battalions also). To alleviate this situation, qualified specialists from other sections within the unit must perform the tasks of operations personnel.

OBSERVATION: TOE 5-117D should be modified to include an operations sergeant and one clerk to handle equipment and personnel dispositions and to prepare reports of the unit's varied activities.

ITEM: TOE 5-117E should retain a direct support maintenance capability for "ordnance" as well as "engineer" equipment.

DISCUSSION: It is understood that the new TOE 5-117E deletes the "ordnance" DS capability. This is believed to be a serious mistake. This battalion, for example, simply could not have accomplished its mission with the same speed and flexibility without this capability. All maintenance must be immediately responsive and available full time for all vehicles and equipment. For example, the

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dump truck is as critical a piece of construction equipment as the bull dozer depending upon the type and nature of projects; the 3/4 ton platoon truck is, on our island project, one of the most critical items - for all uses such as command, food, parts, communications - often even more critical than a heavier piece of equipment. Since the construction battalion almost habitually works at remote, distant construction sites (prior to establishment of, or distance from, other DS units) the ability to make major, DS-type repairs at those sites is imperative. Further, with such a concentration of equipment and vehicles as in this type battalion, it is nonsensical to arbitrarily divide-up types of maintenance by types of rolling stock.

OBSERVATION: TOE 5-117E should continue to include DS maintenance capability for repair of "ordnance" as well as "engineer" equipment.

### c. Logistics

#### Commercial and Non Standard Equipment

ITEM: Mailing system for parts support of commercially designed and non standard equipment needs revision.

DISCUSSION: The battalion supports several commercial and non standard items of equipment which must be procured directly from manufacturers outside the Army Supply System. Repair parts for these items are normally procured UP of 1st Logistical Command Regulation 750-17, which requires that the Depot Address Code and Unit Identification Code be indicated. Once the part is received, the Unit Code is often overlooked and the item is often misplaced in depot or shipped out as unidentifiable. This is extremely frustrating, since lead-times for such procurements are already long.

OBSERVATION: Requisitions should be submitted using only the Unit Identification Code, (omitting the Depot Address Code) to insure proper delivery of the parts to the requesting unit.

#### Asphalt Procurement

ITEM: Present asphalt available in Vietnam is not the proper type for local climatic conditions.

DISCUSSION: It has been noted in Vietnam that a common cause of failures of asphaltic concrete pavement are rutting and shoving of the pavement itself. Although there are other reasons for this type of failure (principally poor base preparation) a frequent reason for failures is the type of asphalt used (AP-3, penetration grade 85-100). This type is a "medium" asphalt and recommended for use in cold climates (because "hard" asphalts such as AP-4 or AP-5 would become brittle at low temperatures). The Asphalt Handbook, 1965 edition, published by the Asphalt Institute, page 6, recommends that for hot climate, AP-5 penetration grade 60-70 be used.

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OBSERVATION: After present stock of AP-3 is exhausted, AP-5 be procured for Vietnam paving requirements.

### Scored-Out Equipment

ITEM: The expeditious resupply of scored-out equipment is not being accomplished.

DISCUSSION: The battalion has had numerous items of construction equipment (e.g. 10 ton rock rollers, 7½ - 50 pneumatic towed rollers, earth auger, 16S mixers, 250 CFM compressors, and 20 ton truck mounted cranes) on order for nearly a year. These items are essential to our construction operations and their unavailability has seriously impaired our effort.

OBSERVATION: Scored-out equipment resupply must be accomplished more rapidly.

### d. Construction Operations

#### Self Help Construction

ITEM: Two distinctly different types of organizations for self help construction employed.

DISCUSSION: The battalion is presently constructing two large cantonment areas at Cam Ranh Bay and Nha Trang, each for nearly 10,000 occupants, with self help personnel. Each project employs a different organization for the self help personnel. The method employed at Cam Ranh Bay retains organizational integrity of tenant units, in that each unit is responsible for constructing its own area. The other method, at Nha Trang, sets up a provisional construction company from among several prospective tenant units.

OBSERVATION: Although, as a general rule, it is felt that the first method (organizational integrity) is better, the provisional company system has so far worked splendidly, if not better, due to strong local command backing and selection of outstanding personnel to staff the organization.

#### Paving of Ditches

ITEM: Use of gunite machine (rented from RMK) versus sand-cement.

DISCUSSION: The battalion has paved several thousand square yards of sand ditches by various means: gunite; sand-cement- both plastic ("wet") and compacted ("dry") types; sand-cement sandbags; and straight concrete slab.

OBSERVATION: Originally, gunite appeared to offer the easiest approach. But our experience has been that plastic (i.e., wet mixed sand-cement) is approximately twice as efficient. It goes down 50 percent faster with about 2/3rds the man power. There was an additional disadvantage to using gunite; the

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gunite machine, at least the one rented from RMK, was comparatively unreliable, and every stoppage of that machine ties up an entire train of plant personnel (sand trucks, cement trucks, water trucks, 600 CFM compressors and required personnel).

### e. Military Engineering

#### Sand Cement

ITEM: Sand-cement as a wearing surface.

DISCUSSION: The battalion has experimented with using sand-cement as a wearing surface with no further treatment except a prime coat. The cement content of the mixed-in-place material was raised to 12 percent instead of the customary 10 percent (this 2 percent increase is recommended by the Portland Cement Association for such instances). The prime coat was applied immediately after final rolling (to facilitate "curing" the cement) and opened to traffic a week later.

OBSERVATION: The surface has withstood heavy construction traffic for over 2 months without any signs of deterioration.

#### Concrete Operations

ITEM: Transit time and standing time for concrete in 5 Ton Dump Trucks.

DISCUSSION: Some segregation and loss of surface water result from extended transit time of concrete in 5 Ton Dump Trucks. Additionally, an idling truck waiting to unload for any length of time tends to accelerate the segregation of the aggregate in the mix by the vibrations of the engine.

OBSERVATION: The maximum transit time for a conventional concrete mix in 5 Ton Dump Trucks should be approximately 45 minutes in temperatures of 80° - 95° F, when haul is mostly on gravel roads. It is further noted that there is a decrease in slump of approximately 1" per 10 minutes of transit time and/or 10 minutes of standing time of the loaded truck. However, by carefully adjusting the mix (i.e., increasing cement content), concrete has been hauled for 1 hour and still retained sufficient water of hydration and, hence, its strength (3,000 psi in these instances). If a truck is required to stand for any length of time before unloading, the engine should be shut off.

ITEM: Oiling the bed of 5 Ton Dump Trucks to prevent concrete from adhering to the truck bed.

DISCUSSION: The use of OE 10, 20 and 30 lubrication oils and diesel fuel oil to prevent concrete from adhering to the dump beds was examined. It was discovered that the use of the lubricated oils adversely affects the final product and causes the surface of the concrete to scale, whereas, the diesel fuel produced no adverse effects.

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OBSERVATION: Diesel fuel works moderately well in preventing concrete accumulation in 5 Ton Dump Truck beds, without adversely effecting the concrete.

### Expedients

ITEM: Using LARCS for compaction of sand cement.

DISCUSSION: Due to the lack of compaction equipment while placing a sand cement LST/landing ramp, an expedient roller of some sort was required. Of the several rubber tired vehicles available, a LARC was utilized because of its weight, large diameter wheels and surface area and smoothness of tread.

OBSERVATION: The smooth treaded LARC tires and a reduced tire pressure produced a compacted sand cement surface very similar to that obtained with a 10 ton wobble wheeled roller, though not as dense as when compacted with the commercial 30 ton self-propelled pneumatic roller.

ITEM: Rehabilitation of dried out POL tank wedge strip gaskets.

DISCUSSION: It was discovered that much of the gasket material used to seal the bolted seams of POL tanks dried out due to long periods of storage in hot weather, and as bolts were tightened, the gaskets cracked. Since new gasket material was not readily available, the gaskets were saturated with graphite and allowed to soak for several hours.


OBSERVATION: After saturation with graphite, the material regained its resiliency and formed a satisfactory seal. After 6 months all seals seemed to be holding satisfactorily.

### Section 2, Part II, Recommendations:

There are no additional recommendations to those inherent in the "observations" in Part I.

7 Incl

- |   |
|---|
| 1. 60 Number 9                            |
| 2. 60 Number 10                           |
| 3. Letter - Equip Recommendation          |
| 4. Synopsis - En Maint Program            |
| 5. The 864th Bridge                       |
| 6. Rehab Program of Nat Hwy System of RVN |
| 7. Equipment Recommendations              |

  
RAY S. HANSEN  
LTC, CE  
Commanding

Withdrawn, Hqs, DA

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EGA-3 (13 May 1967) 1st Ind  
SUBJECT: Operational Report - Lessons Learned (RCS CSFOR-65) for Quarterly  
Period Ending 31 April 1967, 864th Engineer Battalion (Construction)

HEADQUARTERS, 35TH ENGINEER GROUP (CONSTRUCTION), APO 96312, 25 May 1967

THRU: Commanding General  
18th Engineer Brigade  
APO 96377

THRU: Commanding General  
U.S. Army Engineer Command (Prov)  
ATTN: AVCC-R&O  
APO 96491

THRU: Commanding General  
U.S. Army, Vietnam  
ATTN: AVCGH-DH  
APO 96307

THRU: Commander in Chief  
U.S. Army Pacific  
ATTN: GPOP-OP  
APO 96588

TO: Assistant Chief of Staff for Force Development  
Department of the Army (ACSFOR-DA)  
Washington, D.C. 20310

This report adequately covers the major activities of the 864th Engineer Battalion (Construction). The comments and recommendations are generally concurred in and the following additional comments are furnished.

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EGA-3

25 May 1967


SUBJECT: Operational Report - Lessons Learned (RCS CSFOR-65) for Quarterly  
Period Ending 31 April 1967, 864th Engineer Battalion (Construction)

a. Reference Section 2, Part 1, Paragraph a, Personnel.

ITEM: Shortage of skilled electricians and plumbers: Construction in the theater of operations has progressed beyond the stage where on-the-job trainees can master the sophisticated electrical and plumbing requirements. Unsuccessful efforts have been made at Group level to establish electrical schools to train personnel in this critical skill. Consolidating those few individuals capable of performing this craft produced a group of electricians who could install required wiring. Training for unskilled individuals, while producing some results, did not compensate for the loss of capability suffered by units losing their most capable electricians. While individual projects were completed, projects in general lagged. An increase in training of electricians and plumbers in CONUS would greatly increase the construction capability of units in the field.

b. Reference Section 2, Part 1, Paragraph b, Organization.

ITEM: TOE 5-117D does not make provisions for an Operations Section:  
TOE 5-117D should be modified to include an Operations Section. As this modification must be initiated at Battalion level, the 864th Engineer Battalion will be notified to request the desired changes.

  
G. H. NEWMAN  
Colonel, E  
Commanding

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### THE 864TH BRIDGE

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When the 864th Engineer Battalion (Construction) was assigned the project of rehabilitating the National Vietnamese Highway, QL-1, it was faced with the problem of narrow and aged bridges which did not meet width or strength requirements. In searching for a solution to the problem, several courses of action were considered. Many of the bridges could be replaced by culverts; however, the need remained for a short span, high capacity bridge which could replace many of the old bridges or most of the old culverts with a minimum of effort, time, traffic interruption or exposure to enemy harassment.

During this time, an article in Rural Roads Magazine describing how Logan County, Arkansas had replaced several of their bridges when faced with a similar situation gave us an idea. Their solution was to precast concrete "channel" beams and place them on poured-in-place abutments. The configuration on their beams were an inverted "U" with a 1 foot depth and a 3 foot width. Since the facility, materials and some local labor for precasting were readily within our resources, it was decided to use this type of construction for the culverts and shorter bridges.

During design, the dimensions of the beams changed drastically because we were designing for a class 50 load (HACV standard), while the Logan County Bridges were designed for a class 15 load. Our final dimensions for the beams were 6' wide and 2'-6" high with four of these beams forming a two-lane, 24' roadway. Due to the considerable volume of foot and bicycle traffic in the area, a 4 foot walkway beam with curbs and handrails was added to each side. As of this date, all beams for

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the first bridge have been precast and will soon be in place. 18

The following is a short synopsis of the computations for design of the beam. The illustrations show typical cross sections and construction techniques. Design and construction techniques were coordinated with US aid and RWN Ministry of Public Works representatives.

### CALCULATIONS FOR BRIDGE

Design is for Class 50 two way bridge.

$$\begin{aligned} \text{Moment for 20' beam} &= 467 \text{ kip/lane} \\ + 0.15 \text{ impact factor} &= 112.5 \text{ kip/lane} \\ \text{Design Moment} &= 579.5 \text{ kip/lane} \end{aligned}$$

$$\begin{aligned} \text{Since there are two beams per lane } M_s &= 289.7 \text{ kip} \\ V &= 62.75 \text{ kip} \end{aligned}$$

Main Reinf:

$$A_s = \frac{M_s}{f_s j d}$$

$$A_s = \frac{289.7 \text{ kip}(12")}{18 \text{ ksi}(23.8")}$$

$$A_s = 6.85 \text{ sq. in. Use 4 \# 9's and 4 \# 8's}$$

Shear Reinf:

$$V' = V - V_c$$

$$V' = 62.75 - 37.95$$

$$V' = 24.8 \text{ kip}$$

$$A_v = \frac{V'(s)}{f_s j d}$$

$$A_v = \frac{(24.8)(10)}{18 \text{ ksi}(23.8)}$$

$$A_v = 0.587 \text{ sq. in. Use 2 \# 5's @ 10"} \quad \text{spacing (s) by geometry} = 10"$$

Transverse Reinf:

$$\text{Maximum wheel load (P) for Class 50} = 20 \text{ kip}$$

$$\text{Spacing of beams (s)} = 5.583'$$

$$\text{From FM 5-312 } E = 6.5 + 2.5 = 5.85'$$

$$M = \frac{.23P(s)}{E} = \frac{.23(20)(5.583)}{5.85} = 4390 \text{ ft lb.}$$

$$\text{Depth} = \sqrt{\frac{M}{200}} = \sqrt{\frac{4390}{200}} = 4.7 \text{ in. Use 5's total depth } 7"$$

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$$A_s = \frac{M}{200d} = \frac{4390}{2000d} = 0.439 \text{ sq. in./ft} \text{ Use \#4 @ 10" \#5 @ 10"}$$

Longitudinal Reinf:

$$A_s = \frac{A_s \text{ (transverse reinf)}}{\sqrt{s}}$$

$$A_s = \frac{.439}{\sqrt{5.583}} = 0.186 \text{ sq. in. Use \#4 @ 12" o/c}$$

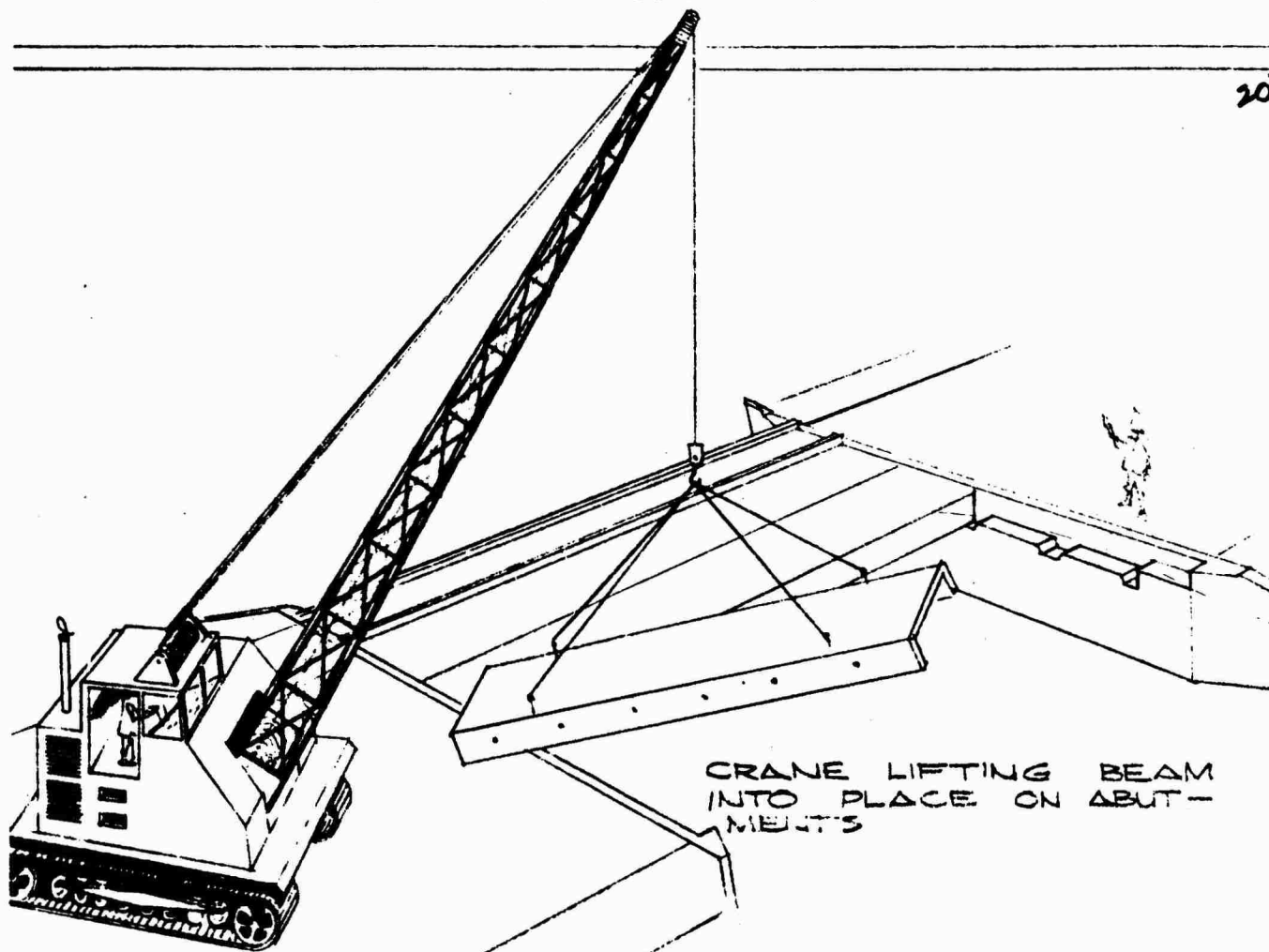
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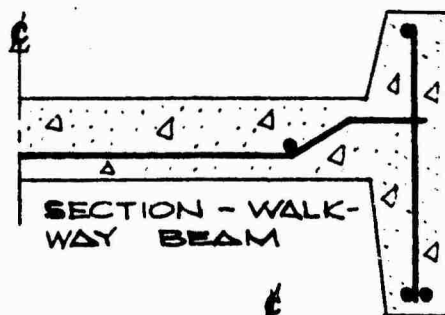
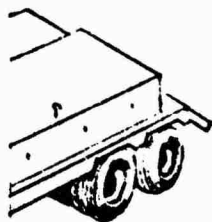
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SECTION - COMPLETED BRIDGE

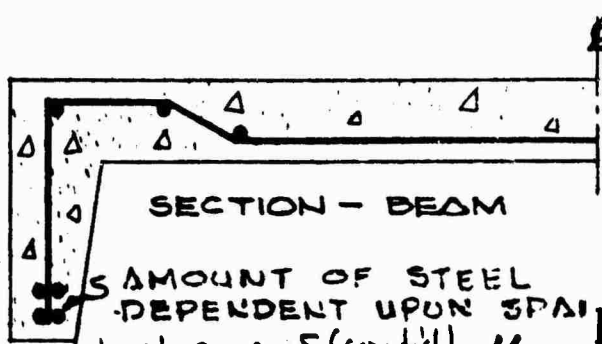
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CRANE LIFTING BEAM  
INTO PLACE ON ABUT-  
MENTS



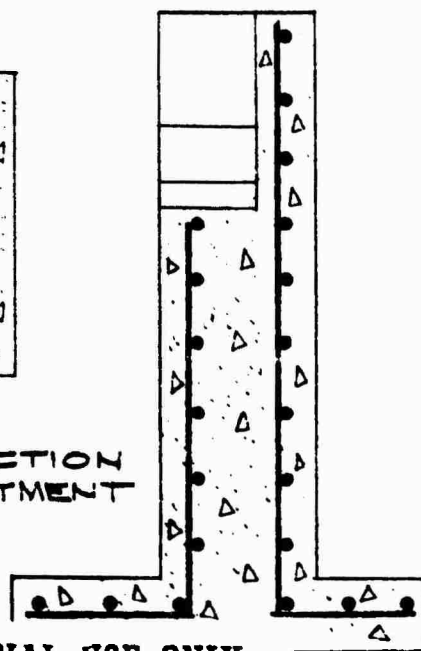
SECTION - WALK-  
WAY BEAM



SECTION - BEAM

AMOUNT OF STEEL  
DEPENDENT UPON SPA  
Inclosure 5 (cont'd)

SECTION  
ABUTMENT



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### Rehabilitation Program of National Highway System of RVN

On 15 March 1967 the 864th Engineer Construction Battalion began the major project of QL-1 Road Rehabilitation. The first phase of five encompassed the section of road from the QL-1-My Ca intersection to Dong Ba Thin, a distance of 3.8 miles. Briefly, the methods of upgrading the existing road are as follows:

1. HD-16 dozers with mounted hydraulic rippers scarify the existing penetration macadam road surface.
2. D7E dozers with blade-mounted ripper teeth complete scarifying process.
3. Road graders wind row scarified material to produce even distribution over existing road width.
4. Where possible, road is widened to 40 feet (24' roadway, 8' shoulders) and rough drainage ditches constructed with existing materials. Some borrow is necessary for low spots.
5. Borrow material (presently laterite) is then hauled and placed in loose 8" lifts with 290M tractor-scrapers and dump trucks. The number of lifts depends upon the height the road must be built up, but it is always at least one lift.
6. Road graders wind row material and initial compaction with sheepfoot rollers begin. The full 40 foot width is compacted until rollers "walk out". Initial shaping of road and ditches follows.
7. Fine rolling is by a 30 ton self-propelled "Tampo" pneumatic roller at optimum moisture content. Water is added as required.

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8. Quarry "scalpings" (two inch minus rock) is then hauled and placed on road; the roadway is then shaped (crowned) and compacted with a 10 ton rock roller and the 30 ton SP "Tampo".

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9. Road is then ready for prime coat of asphalt cutback (MC-0) at 0.2 gallons per square yard.

10. After curing of prime coat the road is paved with 2½" of asphaltic concrete (made with AP-3 bitumen).

Road paving of Phase I of the project was completed on 3 May 1967, just 3 days over our initial forecast. Because roadway and shoulder width requirements were changed during construction, some additional work on Phase I is being finished concurrently with Phase II.

A tentative schedule for the remaining four phases is as follows:

<u>PHASE</u>	<u>LOCATION</u>	<u>DISTANCE</u>	<u>START</u>	<u>END</u>
2	My Ca - Ba Ngoi	7.5 miles	1 May 1967	15 Jul 1967
3	Dong Ba Thin - Suoi Vinh	6.0 miles	16 Jul 1967	30 Sep 1967
4	Suoi Vinh - Suoi Toi	6.2 miles	1 Oct 1967	30 Nov 1967
5	Suoi Toi - Dien Khanh	6.4 miles	30 Nov 1967	31 Jan 1968

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### Equipment Recommendations

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The following comments on equipment were provided for the 18th Engineer Brigade in reference to USACDC Engineer Agency letter of 13 January 1967.

1. Roller, Pneu, SP, Hvy: Highly Recommended

However, we recommend a slightly heavier model, ballastable to about 30 to 40 tons to be able to compact to meet military load requirements. We rent similar "Tampo" rollers which ballast to 25 tons and do not compact quite enough. These pneumatic rollers have been absolutely invaluable for such jobs as road and airfield subgrades and bases (cohesive or granular), soil-cement, and hot mix pavements.

2. Roller, Road, Sheepsfoot, Towed: Not Recommended

a. No significant improvement over existing sheepsfoot rollers, i.e: restricted mobility because of being towed; not really high-speed due to small round feet; and, since the need for compaction is nearly continuous, a towed roller constantly ties up a prime mover tractor.

b. We strongly recommend, in lieu thereof, a self-propelled segmented pad roller weighing (ballasted) about 30 to 40 tons. Two examples which have good reputations are the Hyster Q450A (perhaps, but not necessarily, too big) and the Rex "Pactor 3-30" (good size). Many other manufacturers are also producing this popular, efficient type of compaction equipment. In general, I urge that all compaction equipment (except vibratory rollers, as discussed below) be self-propelled. The day is past that we can only occasionally compact with slow, clumsy towed rollers. Today every road, every airfield, every hardstand needs rolling to take today's heavy loads.

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Comments on Items Described in USAFDC Engineer Agency Letter  
of 13 January 1967

### 3. Roller, Road, Vibrating, Towed: Highly Recommended

a. The vibratory roller could be a towed type, as illustrated in your inclosure, because the need is not as constant as for other rollers. At Cam Ranh Bay, for example, a self-propelled type would be best, but such a concentration of granular materials is a bit uncommon. Incidentally, vibrating rollers have been especially valuable for compacting soil-cement, which has been widely used for roads and hardstands.

b. For your information, we have heard (but cannot substantiate) that a make and model such as the "Hyster G200B" has a much better reputation than the make you illustrated, by virtue of the reliability and maintainability of drive components.

### 4. Roller, Road Vibrating, Light: Recommend Substitute

a. This is a good item and would be better than nothing for the small jobs. However, it is awkward to move around structures such as abutments and foundations.

b. Recommend, in lieu thereof, a hand-guided, plate type vibrator. This could be used close to the structures and for close work in most craters and patches. The larger vibrating rollers, item 3 above, would be good for large craters and patches.

### 5. Roller, Road, 2 Drum, Tandem: Highly Recommended

The heavier weight and greater maneuverability than our present 2 drum tandem roller are very desirable features.

### 6. Roller, Road, 3 Drum, Tandem: Highly Recommended

The heavier weight and greater maneuverability than our present 3 drum tandem roller are very desirable features.

### 7. Tamper, Earth, Compactor: Highly Recommended

Recommend that this type of item come complete with all tools

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Comments on Items Described in USACDC Engineer Agency Letter  
of 13 January 1967

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such as drill, breaker, cutter, and spade. The Atlas Copco "Cobra" is a similar machine with an outstanding reputation. There are many jobs on which each platoon could use one of these items in day-to-day work, especially in remote sites where a compressor cannot go.

### 8. Ditch Sloping Attachment for Graders: Recommended

a. In tropical or underdeveloped areas, where road shoulders are weak or non-existent, it is now virtually impossible to construct or repair ditches when wet. The only item now available for such tasks is the clambucket on the crane--a slow, tedious method. One of these attachments would be valuable in each battalion.

b. A truck-mounted "Gradall" hydraulic backhoe also would be valuable for these uses. Although not quite as fast as a grader for ditch work, the Gradall is much more versatile for many tasks. If there were a choice between the grader attachment and a Gradall, we would recommend the latter.

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